PATENT SPECIFICATION 1,178,256

DRAWINGS ATTACHED.

1,178,256

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COMPLETE SPECIFICATION.

Improvements in or relating to Control Means for Hydraulic Units.

We, LINDE AKTIENGESELLSCHAFT, a German Company of 62 Wiesbaden, Hildastrasse, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to an improved hydraulic motor control system for a vehicle of the kind which is supported by steerable ground-engaging wheels and is propelled by hydraulic motors driving ground-engaging wheels of the vehicle on opposite sides thereof.

As priorly known, for example, from Specification No. 849,196, the two hydraulic motors may receive pressurised fluid from the same, variable-capacity pump, and may be themselves of variable capacity.

As priorly known, e.g. from Specification No. 948,779, linkage means may be provided interconnecting the control means of the motors which is actuable in response to a pressure difference at the motors, e.g. caused by the unequal rate of rotation of the drive wheels as the vehicle turns a corner, equally and oppositely to vary the capacities of the motors so that in all conditions of operation the sum of the capacities of the motors remains in predetermined ratio to the capacity of the pump.

However, for a more efficient utilisation of the available energy it is desirable that in conditions when the drive wheels are under different load, though rotating at the same speed, the torque output of the motor associated with the more heavily loaded drive wheel should be greater than that of the motor driving the more lightly loaded wheel. For example, when a tall, heavy vehicle is traversing a slope the drive wheel on the downhill side is more heavily loaded than that on the uphill side. Another example is that of an agricultural vehicle which is obliged to move with one drive wheel at the bottom of a plough furrow while its other drive wheel is on level ground. In this case the wheel on level ground is more lightly loaded and encounters less rolling resistance.

It is therefore the principal object of the present invention to provide, in a vehicle of the kind described, a transmission system which is adjustable between a normal setting in which equal torque is applied to both drive wheels and a second setting to be used when one drive wheel is under heavier load than the other, in which second setting the motor associated with the more heavily loaded wheel has a greater torque output than the other, it being presupposed that both drive wheels continue to rotate at the same speed ratio.

According to the invention there is provided a vehicle of the kind steered by the angular movement of ground-engaging wheels by which it is supported and including variable-capacity hydraulic motors arranged to drive respective driven wheels on opposite sides of the vehicle to propel the same, a pump adapted to deliver hydraulic fluid at variable pressure to the motors, and an hydraulic motor control system comprising linkage means interconnecting the control means of the motors, with the pump control means, the length of said linkage means between the pump control means and the respective control means of the motors being adjustable between a normal setting in which said linkage means serves to maintain the motors at equal capacities when said driven

wheels rotate at the same speed and a second setting in which the length of said linkage means between the pump control means and the respective control means of the motors is equally and oppositely varied whereby said linkage means serves to maintain the motors at different capacities when said driven wheels rotate at the same speed, the arrangement being such that in said second setting of said linkage means a greater torque is applicable to a selected one of said driven wheels by the associated motor than is applied to the other with said driven wheels rotating at equal speed.

The motors are preferably hydraulically interconnected in parallel.

The linkage means preferably extends between the control means of the motors and is connected to the pump control means intermediate the control means of the motors, and means is preferably provided for varying the effective length of the linkage between its point of connection to the pump control means and each motor control means, said effective length of the linkage between the pump control means and each motor being equal in the normal setting of the linkage and different in the said second setting of the linkage.

The system may comprise a substantially quadrilateral arrangement of articulated links arranged between a pair of thrust rods controlling the stroke capacities of the respective motors, said arrangement including a lever which is manually movable to alter the shape of said arrangement, thereby equally and oppositely altering the effective length of the linkage between the pump control means and the respective motors.

Alternatively, the stroke capacity of each motor may be controlled by a thrust rod integral with the piston of a piston-and-cylinder assembly articulated between the pump control means and the respective motor, the pistons being equally and oppositely movable in their respective cylinders upon actuation of a valve controlling the supply of pressurised fluid to the cylinders on one side or the other of the respective pistons.

Two embodiments of a transmission system in accordance with the present invention will now be described by way of example with reference to the accompanying diagrammatic drawings in which:—

Figure 1 illustrates an agricultural vehicle propulsion system, in which the motor control system in accordance with the invention is manually adjustable, and

Figure 2 illustrates a propulsion system similar to that of Figure 1, but in which adjustment of the motor control system of the invention is effected by remote control means.

Referring to Figure 1, this shows a propulsion system for an agricultural tractor with two front wheels 1 angularly movable to steer the vehicle, and two rear wheels 2. A prime mover in the form of an internal combustion engine 3 drives a variable displacement hydraulic pump 5 through a shaft 4, the pump 5 being linked through lines 6 and 7 with two hydraulic motors 8 and 9 (which are thus mutually connected in parallel) each of which drives a respective rear wheel 2, and each of which is of adjustable capacity.

The control means for adjusting the displacement of the pump 5 is linked through a coupling rod 10 with a servo-cylinder 11 which, by means of an arbitrarily manually operated control valve 12, is pressurised by an auxiliary pump 13. The control means of the pump 5 is also connected to a double-arm lever 14. To each end of the lever 14, a sleeve 15 is articulated, and in each of these sleeves 15 a coupling rod 16 is arranged in spring-loaded fashion (spring 17) such that it cannot move in relation to the sleeve 15 without compressing the spring 17. The free end of the coupling rod 16 is in each case connected to the control means of an hydraulic motor 8 or 9 as the case may be. The spring 17 is such that the adjusting forces which can be developed in the coupling rod 16 by the restoring force of a hydraulic motor 8 or 9, is less than the preload of the spring 17, so that such forces cannot produce any displacement of the coupling rod 16 in relation to the sleeve 15.

On the sleeve 15 associated with the hydraulic motor 8, a lever 18 is mounted, and on that associated with the hydraulic motor 9 a lever 19, the levers 18 and 19 being connected with one another through a link 20. The lever 19 is arbitrarily pivotable, and on displacement from its normal position into a second position, the position of each coupling rod 16 in relation to its associated sleeve 15 is altered. In this way, the coupling elements constituted by the components 15 to 17 and linking the two hydraulic motors 8 and 9 are adjustable so that the effective length of the linkage between the control means of the pump 5 and the control means of the respective motors 8, 9, is altered equally and oppositely so that the two hydraulic motors 8 and 9 are set to mutually different capacities.

Referring now to Figure 2, the components referenced 1 to 14 and 16 correspond to the similarly referenced components in Figure 1.

In place of the sleeve 15, however, cylinders 21 are provided into the ends of which pistons 22 attached to the coupling rod 16 are slid. Springs 17*a*, like the springs 17 of Figure 1, again determine the basic positions of the coupling rods 16 in relation to the cylinders 21, being simply arranged

in a different relationship thereto in this case. The cylinders 21 are double-acting and are connected *via* two lines 23 and 24 to the auxiliary pump 13 through an arbitrarily and manually operable control valve 25. If the control valve 25 is in the shut-off position shown in the drawing, then the cylinders 21 with the associated pistons 22 and the springs 17*a* act as coupling elements in the system 14, 16, 17*a*, 21, 22, of equal effective length between the pump control means and the motor. However, if the control valve 25 is operated, then the pressurised fluid supplied by the pump 13 effects a change in the disposition of the coupling element system such that the hydraulic motor 8 is set to a different induced capacity from that to which the hydraulic motor 9 is set. Also, adjustment of the control valve 25 in both directions is possible, so that adaptation to any circumstances arising can be carried out regardless of whether it is the wheel 2 driven by the hydraulic motor 8 which is running in a furrow or that driven by the hydraulic motor 9.

A valve (not shown in the drawing) can be arranged between the lines 23 and 24, which valve ensures that in normal operation, e.g. when the tractor is travelling on a road, the pistons 22 in both cylinders 21 return to their normal positions.

WHAT WE CLAIM IS:—

1. A vehicle of the kind steered by the angular movement of ground-engaging wheels by which it is supported and including variable-capacity hydraulic motors arranged to drive respective driven wheels on opposite sides of the vehicle to propel the same, a pump adapted to deliver hydraulic fluid at variable pressure to the motors, and an hydraulic motor control system comprising linkage means interconnecting the control means of the motors, with the pump control means, the length of said linkage means between the pump control means and the respective control means of the motors being adjustable between a normal setting in which said linkage means serves to maintain the motors at equal capacities when said driven wheels rotate at the same speed and a second setting in which the length of said linkage means between the pump control means and the respective control means of the motors is equally and oppositely varied, whereby said linkage means serves to maintain the motors at different capacities when said driven wheels rotate at the same speed, the arrangement being such that in said second setting of said linkage means a greater torque is applicable to a selected one of said driven wheels by the associated motor than is applied to the other with said driven wheels rotating at equal speed.

2. A vehicle as claimed in claim 1 wherein the motors are hydraulically interconnected in parallel.

3. A vehicle as claimed in either preceding claim, wherein the linkage means extends between the control means of the motors and is connected to the pump control means intermediate the control means of the motors, and wherein means is provided for varying the effective length of the linkage between its point of connection to the pump control means and each motor control means, said effective length of the linkage between the pump control means and each motor being equal in the normal setting of the linkage and different in the said second setting of the linkage.

4. A vehicle as claimed in claim 3, and comprising a substantially quadrilateral arrangement of articulated links arranged between a pair of thrust rods controlling the stroke capacities of the respective motors, said arrangement including a lever which is manually movable to alter the shape of said arrangement, thereby equally and oppositely altering the effective length of the linkage between the pump control means and the respective motors.

5. A vehicle as claimed in claim 3, wherein the stroke capacity of each motor is controlled by a thrust rod integral with the piston of a piston-and-cylinder assembly articulated between the pump control means and the respective motor, the pistons being equally and oppositely movable in their respective cylinders upon actuation of a valve controlling the supply of pressurised fluid to the cylinders on one side or the other of the respective pistons.

6. A vehicle substantially as hereinbefore described, with reference to Figure 1 of the accompanying diagrammatic drawings.

7. A vehicle substantially as hereinbefore described, with reference to Figure 2 of the accompanying diagrammatic drawings.

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1178256 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1

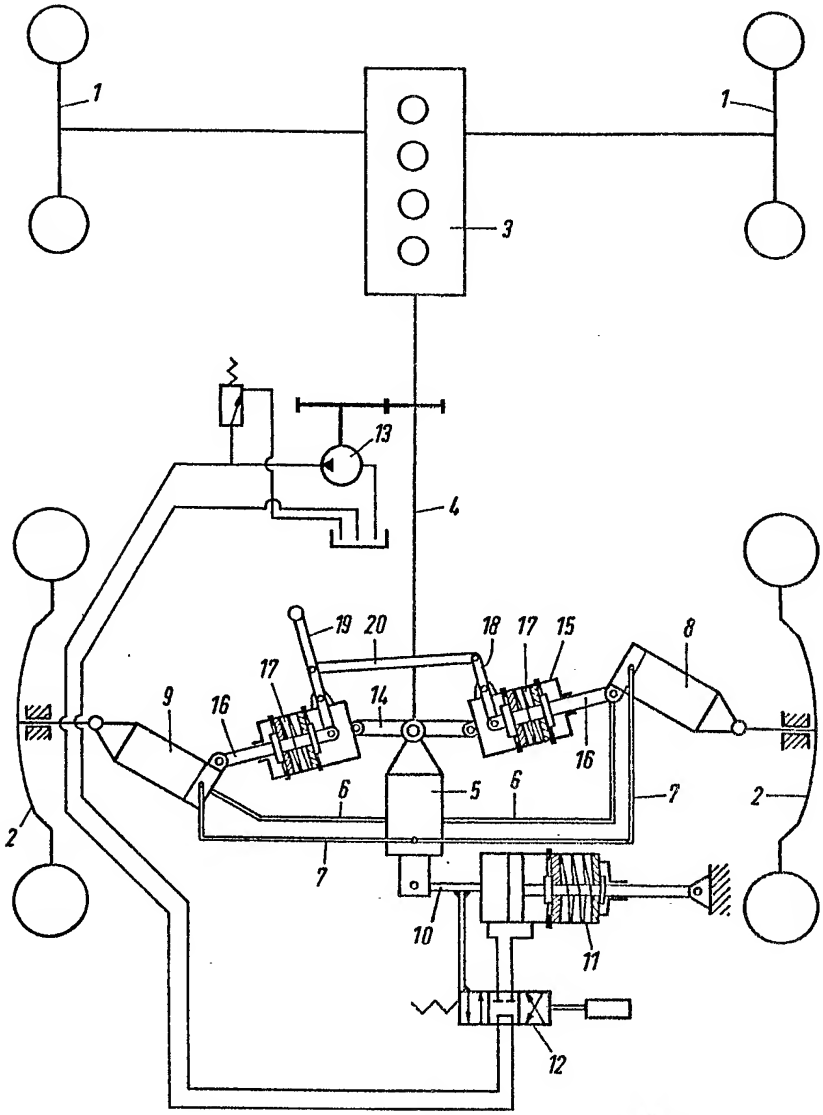

Fig. 1

1178256 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

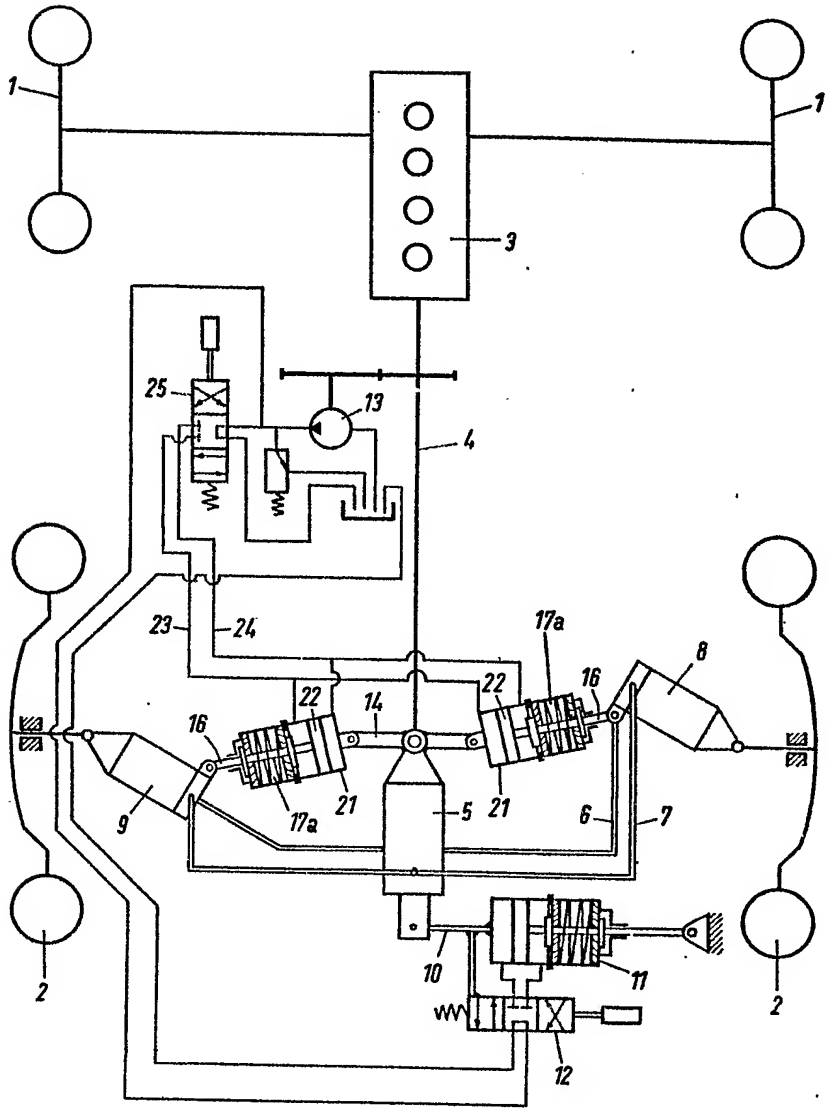

Fig. 2